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ENERGY CONSUMPTION GUIDE 68

The UK corrugated packaging industry

Do you want to improve your profitability and environmental performance? Then read on...

- **Compare your company's performance with benchmark data**
- **Identify the best energy consumption figures currently achieved within your industry sector**
- **Prepare a strategy of simple management practices which will reduce energy consumption and associated costs**

BEST PRACTICE PROGRAMME
ENERGY EFFICIENCY

ENERGY CONSUMPTION GUIDE 68

BEST PRACTICE PROGRAMME

BACKGROUND

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In the corrugated packaging industry, energy costs are typically between 3 and 5% of annual turnover. Improving energy efficiency will reduce production costs, thereby improving competitiveness. Reductions in energy consumption not only save money and valuable energy resources, but also reduce the harmful emissions that result from using fossil fuels.

It is difficult to establish how much energy you should be using unless you are able to compare your energy performance with that of others within the same industry.

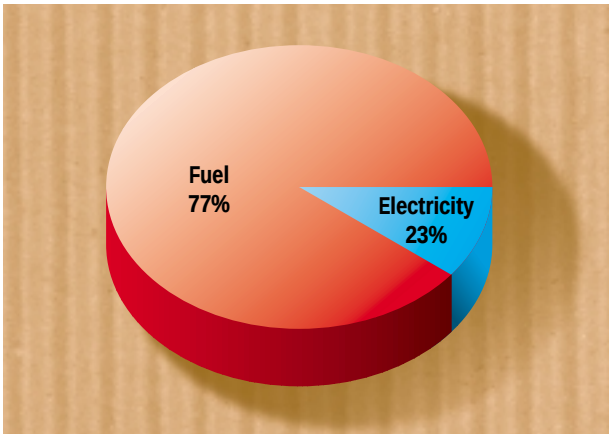

Fig 1 Typical split of fuel and electricity consumption (in energy units)

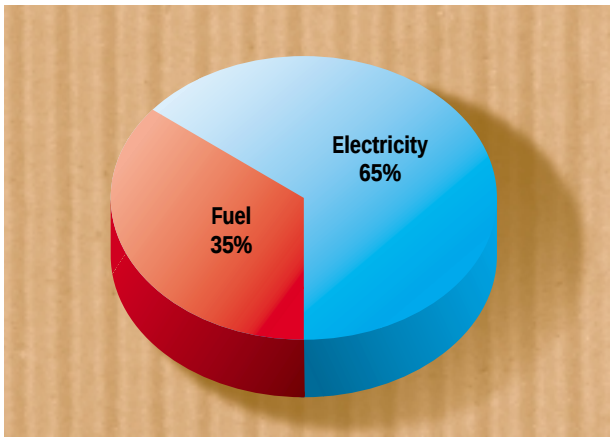

Fig 2 Typical split of fuel and electricity costs (in cost units)

THE SURVEY

In 1996, the then Department of the Environment (DOE) commissioned a survey to examine energy consumption within the UK corrugated packaging industry. With the co-operation of the British Fibreboard Packaging Association (BFPA), now the Corrugated Packaging Association (CPA), confidential questionnaires were prepared and sent to all the companies within the industry sector. The completed questionnaires were collected and independently analysed to provide the necessary benchmark information.

Completed questionnaires were received from a variety of manufacturers, both large and small. Detailed energy consumption and cost information was returned by companies whose production represents about 25% of the UK total.

THE RESULTS

Energy Usage Across The Sector

Annually, a total of over two million tonnes of corrugated packaging is produced by more than 90 production sites throughout the UK.

The UK corrugated packaging manufacturing industry purchases 902 million kWh of energy at a cost of approximately £16 million/year. The use of this energy results in the annual emission of over 370,000 tonnes of carbon dioxide, a major 'greenhouse' gas.

General Fuel And Electricity Consumption Trends And Ratios

Almost all of the respondent companies use natural gas as the principal fuel. Many have dual fuel capability and are able to use heavy, medium or in a few instances, light fuel oil as an alternative in the event of an interruption to the gas supply. Those respondents still using oil as a primary fuel at the time of the survey stated that conversion to dual fuel or gas was underway or imminent. From the survey and given current negotiable gas prices, gas, with preferably a dual fuel capability, is considered desirable.

There is little or no electricity generation within the respondent companies' plants. Therefore, it can be

CONCLUSIONS OF THE SURVEY

assumed that most of the fuel is used for heating, with lighting and power requirements being served by purchased electricity.

Fig 1 shows the typical balance of fuel and electricity consumption within the industry. Generally the total energy requirement will comprise 77% fuel and 23% electricity.

Fig 2 shows the typical balance in cost terms. Generally the electricity cost represents some 65% of total energy expenditure and the fuel cost represents the remaining 35%. This indicates the proportionately higher price paid for electricity, commonly 3 - 5 p/kWh, compared to around 1 p/kWh for gas.

Respondents to the survey were asked to estimate what percentage of the fuel they consume is used for processing and what percentage is related to space heating, domestic hot water, etc.

Fig 3 shows the typical percentage split of fuel use for space heating and process applications determined as a result of the survey.

CONCLUSIONS OF THE SURVEY

- Most of the companies which responded are already seeking ways to reduce energy consumption.
- A few companies are able to log detailed energy information.
- Most companies had sufficient metering to enable a basic monitoring system to be put in place.
- All companies stand to gain from cutting their energy costs.

BENCHMARKS FOR SPECIFIC ENERGY CONSUMPTION AND COST

Specific Energy Consumption is a measure of how much energy is used to make one unit of product. It is a useful tool for measuring your performance over time or for evaluating your performance against others.

Average Specific Energy Consumption and cost information has been derived from the returned

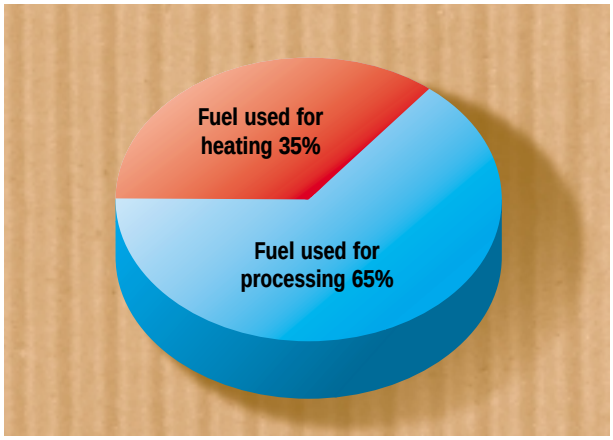

Fig 3 Typical split of fuel use for process and space heating

survey questionnaires which should enable you to compare your energy performance with others in the industry.

The information is contained in Table 1 and is illustrated in Figs 4, 5 and 6. If your performance indicates higher specific fuel and electricity consumption, or your energy costs are higher than the average, then opportunities exist to improve energy efficiency and reduce your costs.

The industry average provides an initial performance target. However, attaining the industry average should be only the first stage in improving and maintaining energy performance. For those companies whose performance is better than average, the concern should be how to maintain that performance or improve it further.

Table 1 Average specific energy consumption and costs determined from the survey

	Energy used (kWh/tonne of paper processed)	Unit energy cost (p/kWh)	Specific energy costs (p/tonne of paper processed)
Fuel	336	0.9	300
Electricity	115	4.7	500
Total Energy	451	1.9	800

HOW MUCH CAN I SAVE?

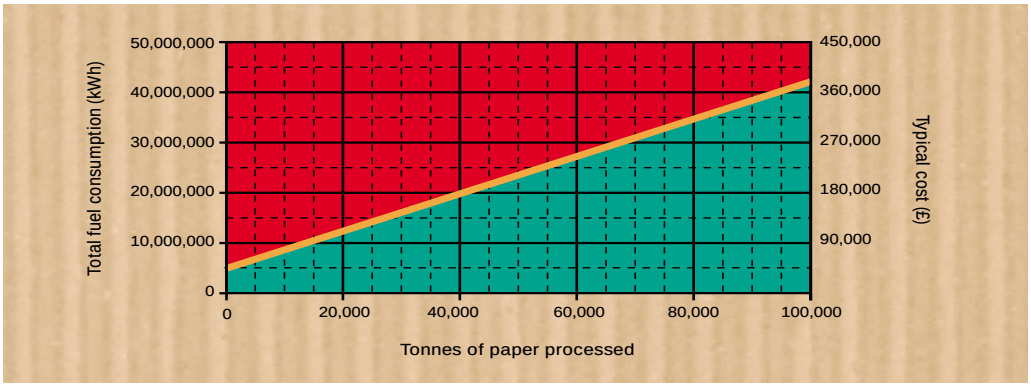

Fig 4 Fuel consumption relates mainly to the efficiency of the corrugating process. Use this chart to see how you compare with your competitors

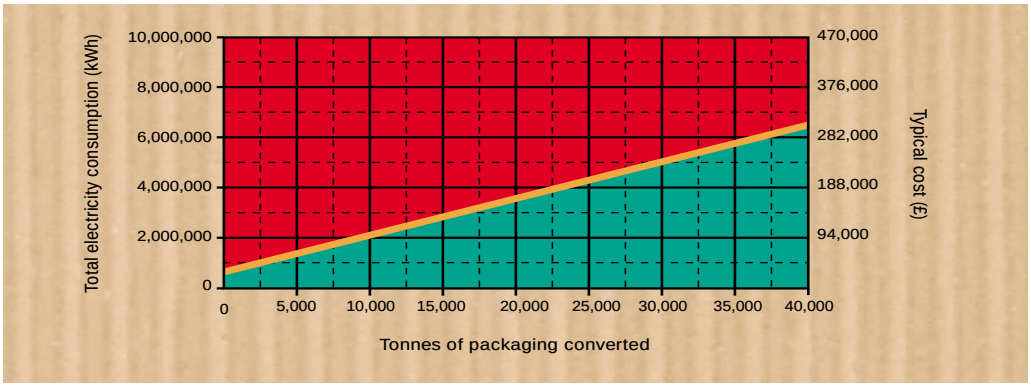

Fig 5 Converting machinery is a big user of electricity. Compare yourself with the rest of the industry to see how efficient you are and what savings could be made

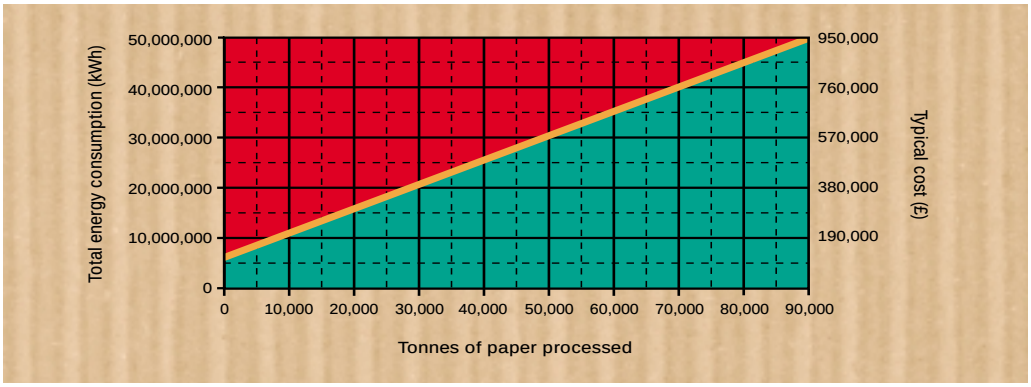

Fig 6 This graph looks at overall energy consumption. It is useful for setting targets and estimating savings

CALCULATING ENERGY USE

Figs 4, 5 and 6 provide specific fuel, electricity and total energy consumption and cost information derived from the industry. This information will allow you to see at a glance how your energy performance compares with that of the other companies in your industry sector.

The diagonal amber lines show the average consumption and cost for the manufacture of corrugated packaging.

Use Figs 4, 5 and 6 to plot your own performance in processing and converting. If your energy consumption falls within the green area then you use less energy than the industry average. If it lies in the red area then you are probably using more than you need. Use the 'cost' axis to estimate how much your business could save through even a modest improvement in energy performance.

THE IMPORTANCE OF SAVING ENERGY

Every pound that you save on your energy bill is a pound of extra profit. At the same time your company is demonstrating its environmental credentials in a clear and positive manner. Both of these are important factors at a time when prices are rising, margins falling and the paper products industry generally is under increasing scrutiny from consumers and environmentalists alike.

Energy saving is truly a 'key business issue'.

WHERE DO YOU START?

Energy consumption and cost can be controlled but first you need to know:

- how you use it;
- how much you use;
- how much it costs.

When you have this information you can adopt practices to improve your energy efficiency. The 'Action Plan' in this Guide suggests areas where there may be potential for savings and identifies the information sources which provide advice regarding relevant technical measures, or management practices.

CALCULATING ENERGY USE

To control your organisation's energy use and expenditure, you must have a clear idea of how much energy is being used to carry out the basic activities of your business. The simple procedure below is all that is necessary for calculating and examining the overall energy consumption at your site.

- Measure the gas, oil and electricity consumed at your site.
- Convert these amounts to a standard energy unit (kWh).
- Calculate your fuel, electricity and total energy use.
- Determine your production (paper processed and packaging converted).
- Plot and compare your annual energy consumption using Figs 4, 5 and 6.

This method can be used to enable you to compare the energy efficiency of your organisation with that of others in your industry sector. Repeating the calculation at regular intervals allows you to keep track of energy use and record energy expenditure over the year, both of which should assist you in energy use and expenditure control.

The method of calculating energy use shown in this Guide will serve as a good basis for compiling energy records.

Measuring Energy Used

The main energy sources used in the corrugated packaging industry are gas and electricity. Many manufacturers make use of various grades of oil as a standby fuel. To calculate energy consumption, readings must be taken from the gas and electricity meters. Fuel oil consumption may be obtained from the fuel oil gauges or by dipping the tanks. A careful note of oil deliveries should be kept so that the gauge readings or tank-dip readings can be assessed correctly.

Energy monitoring is an essential requirement for effective control. Initially the energy use should be measured over a period which can be conveniently

IMPROVING ENERGY EFFICIENCY

related to production, e.g. every week or every month. It is important to establish a regular regime for measurement, i.e. the meter readings should be made on the same day each week and at the same time on that day. Production data for the same period should also be available.

Converting energy used to kWh

To find your total energy use, and to make comparisons, a common energy unit must be used. Energy consumption tends to be quoted in kilowatt-hours (kWh). Electricity is already in kWh, but other fuels should be converted as follows:

Table 2 Conversion factors for different fuel sources

Fuel	Conversion factor (multiply by)
Natural gas in therms	29.3
Gas oil (35 sec) in litres	10.6
Fuel oil (290, 950 and 3,500 sec) in litres	11.3
Coal in tonnes	7,350

Calculating your energy costs

Determine your energy costs by applying the appropriate energy prices to the fuel and electricity consumed during the period. The prices and total costs can be compared using Table 1 and Figs 4, 5 and 6.

IMPROVING ENERGY EFFICIENCY

The energy consumption information contained in this Guide provides an indication of expected performance. The following information outlines some things that you can do to reduce consumption and cut your energy costs. There are a large number of publications produced under the Energy Efficiency Best Practice Programme which provide details of the technologies and techniques suitable for controlling energy consumption in your industry. Relevant publications are identified in the Action Plan.

EFFICIENT USE OF STEAM

Steam is generally used for heating in both the flute forming and drying sections in the corrugator. Steam may also be used for other areas of the operation or for heating. It is important to examine the steam system and determine what scope exists for improved operation. This may be as simple as identifying and curing steam leaks, or assessing the potential for a pressurised condensate return and flash steam heating for lower grade heat loads. There may be potential to save energy by isolating steam supplies to the corrugator during down-time or outside working hours. A revised condensate draining and steam venting procedure may be necessary.

EFFICIENT USE OF ELECTRICITY

The drive mechanisms for the flute forming, single and double backer mechanisms, and the initial guillotining and sheet handling will consume a considerable proportion of the electrical power. Subsequent cutting, slotting, printing, gluing, folding, whether carried out in single stages or as a combined operation on a casemaker or other integrated plant, are all processes which involve the intensive use of electricity. Some of these processes will consume relatively large quantities of power even when idle, i.e. switched on but not in use.

The unnecessary operation or loading of all major power-consuming plant should be identified and prevented. Electrical power consumption and demand control methods, e.g. soft or interlocked starts, should be investigated. Variable speed controls may have potential to replace geared drives where these are used.

Night-time or ‘off-shift’ electricity consumption should be measured and the cause of this consumption identified. Off-shift and/or weekend load can be considerable if care is not taken to switch off all unnecessary plant. Most managers or their engineers will be surprised by the size of the avoidable load they can identify. The cost savings are effectively free.

ENERGY MANAGEMENT

Automated product handling systems, e.g. powered conveyance systems and gantry cranes, will consume significant quantities of electrical power.

ANCILLARY PLANT ITEMS

Other major power consuming plant and areas worthy of investigation include: pneumatic waste extraction and transfer, compressed air for plant operation and control, waste baling and water treatment plants. Some sites also make extensive use of air handling plant. Compressed air leaks should be identified and cured. Effective line isolation outside working shifts will help reduce electrical consumption.

SPACE HEATING AND LIGHTING

Space heating, lighting and small-scale electrical power for factory floor and office areas constitute most of the remaining heat and power loads.

Although individual items may consume only small amounts of energy this can add up to a surprising amount. Don't neglect these areas when trying to cut energy costs - indeed, switching off lights, etc. is a very visible sign of commitment to energy cost savings.

ENERGY MANAGEMENT

Improved energy efficiency can be achieved with a combination of technical changes and effective energy management techniques. These will include monitoring and targeting, staff motivation and training, and the implementation of good energy housekeeping measures.

ACTION PLAN

The following Action Plan is intended to act as a reminder of those areas to which you may first consider devoting effort to reducing your energy consumption and costs.

IMPROVING ENERGY EFFICIENCY - ACTION PLAN

The reduction of energy consumption and cost saving is important because these savings will be reflected directly in the gross profit margin of the business. The environmental benefits must also be considered, e.g. energy saving also results in reduced CO_2 emissions. The Action Plan below identifies some of the key areas to which energy saving effort can be directed.

Energy efficient practices	Potential savings (%)*	Considered ✔	Actioned ✔	EEBPP Publication reference
The efficient use of steam: identify and cure all leaks, steam trap maintenance, consider pressurised condensate lines and flash steam heating for lower grade heat request. Shutdown and isolate the flute forming section outside working hours.	5 - 20			FEB2, GPG30, GPCS274, GPCS339
Soft start or interlocked start for major items of rotating machinery, electrical maximum demand control.	3 - 5			GPG2
Variable speed drives.	5 - 10			GPG2, GPCS270
Power factor correction.	5 - 10			N/A
Efficient space heating.	10 - 15			GPG188, GPG189
Efficient lighting.	30 - 50			GPG119, GPG158, GPG159
Pneumatic waste transfer systems, reduce fan load by ensuring all redundant lines are isolated.	2 - 3			GPCS337
Finishing processes, ensure plant is switched off and electrically isolated outside working shifts.	2 - 5			GPG2
Compressed air efficiency, generation and transmission.	5 - 10			GPG126, ECG40, ECG41, ECG42
Monitoring and targeting.	5 - 10			GPG91
Workforce motivation and training.	5 - 10			GPG84, GPG85
Energy management, general.	20 - 30			GPG31

**Possible savings as a % of current energy use but are not necessarily cumulative.*

The Department of the Environment, Transport and the Regions' Energy Efficiency Best Practice Programme provides impartial, authoritative information on energy efficiency techniques and technologies in industry, transport and buildings. The information is disseminated through publications, videos and software, together with seminars, workshops and other events. Publications within the Best Practice Programme are shown opposite.

Further information

For buildings-related topics please contact:
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Energy Consumption Guides: compare energy use in specific processes, operations, plant and building types.

Good Practice: promotes proven energy efficient techniques through Guides and Case Studies.

New Practice: monitors first commercial applications of new energy efficiency measures.

Future Practice: reports on joint R & D ventures into new energy efficiency measures.

General Information: describes concepts and approaches yet to be fully established as good practice.

Fuel Efficiency Booklets: give detailed information on specific technologies and techniques.

Energy Efficiency in Buildings: helps new energy managers understand the use and costs of heating, lighting etc.